California Environmental Protection Agency

Air Resources Board

Biomass-to-Biofuel Challenges and Opportunities

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Opportunities

Low Carbon Fuel Standard

- Performance-based standard
- Fuel-neutral
- Yet a key driving force for biomass utilization

LCFS Key Objectives

- Reduce carbon intensity of transportation fuel pool by 10% by 2020
- Reduce greenhouse gas emissions (~15 million metric tons in-state in 2020)
- Help achieve AB 32 objective of reducing GHG emissions to 1990 levels by 2020
- Transform State's fuel supply, reducing GHG emissions, and enhancing energy independence/security

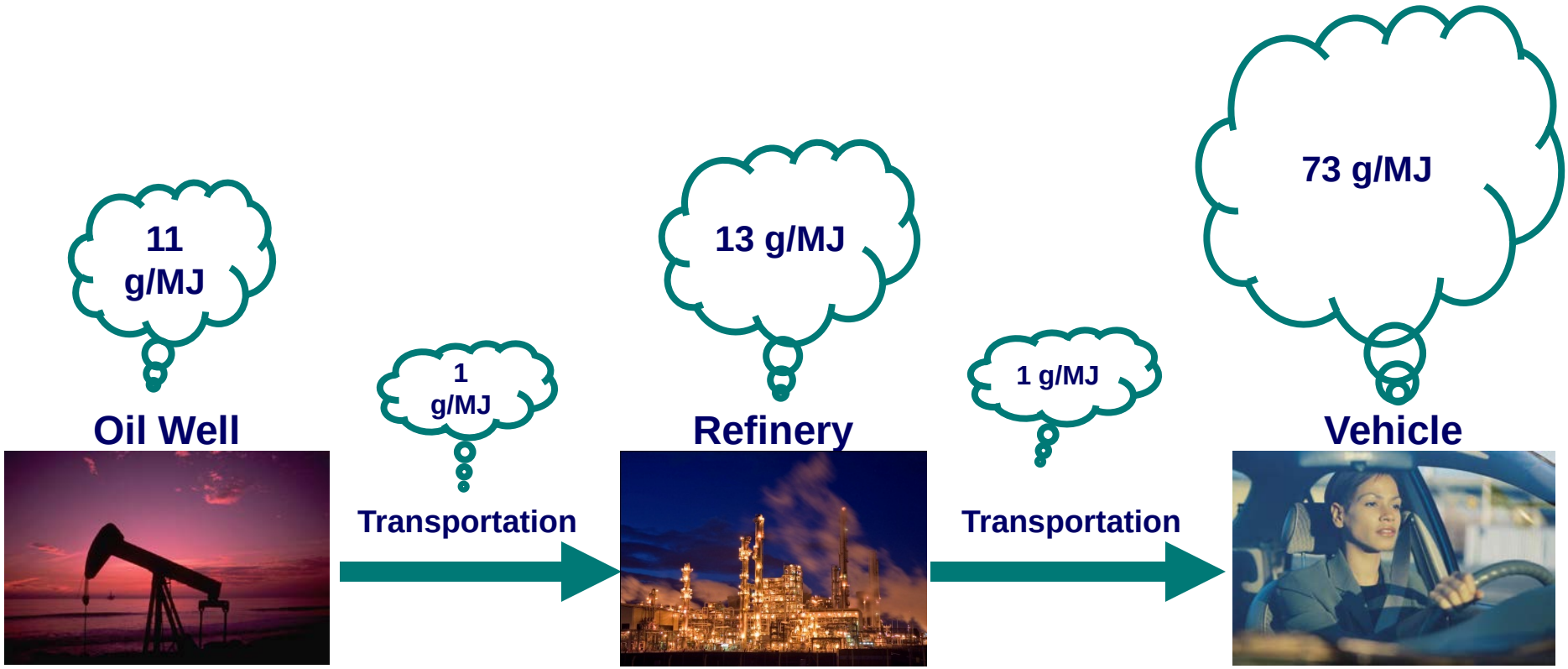
Basic LCFS Requirements

- Sets annual carbon intensity standards for gasoline, diesel, and the fuels that replace them
- Carbon intensity (CI) is the measure of GHG emissions associated with producing and consuming a fuel (gCO_2e/MJ)
- CI based on complete life cycle analysis

LCFS Applies to Regulated Parties

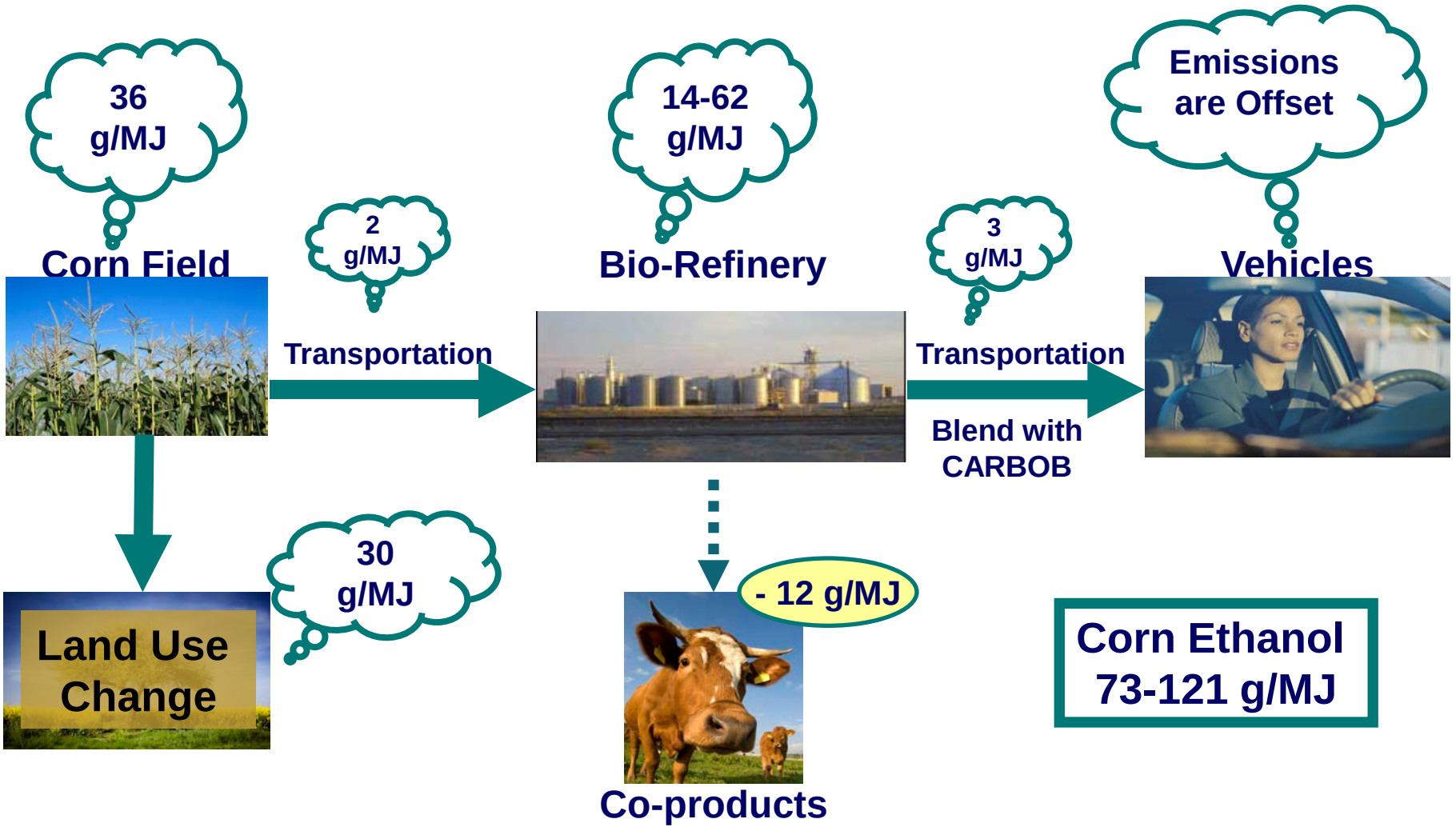
- Providers in California of most petroleum and biofuels are “regulated parties” under the LCFS
- Providers of clean fuels that already meet 2020 target are exempt but can “opt in” to program and earn credits
  - Electricity
  - Hydrogen
  - Natural gas & biogas
- Generated credits can be bought and sold by regulated parties

Fuel Life Cycle – CARBOB

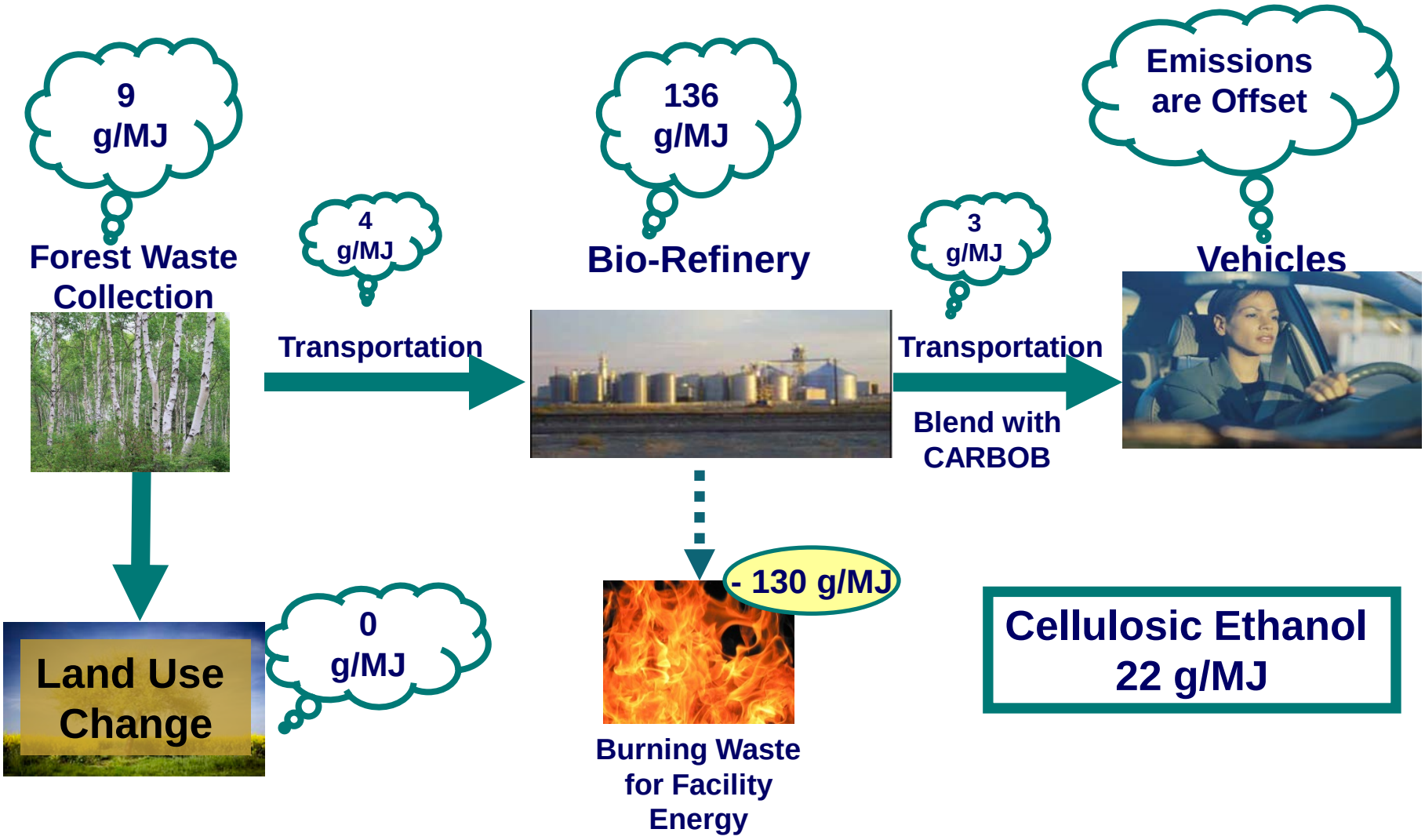


CARBOB
99 g/MJ

Fuel Life Cycle – Corn Ethanol

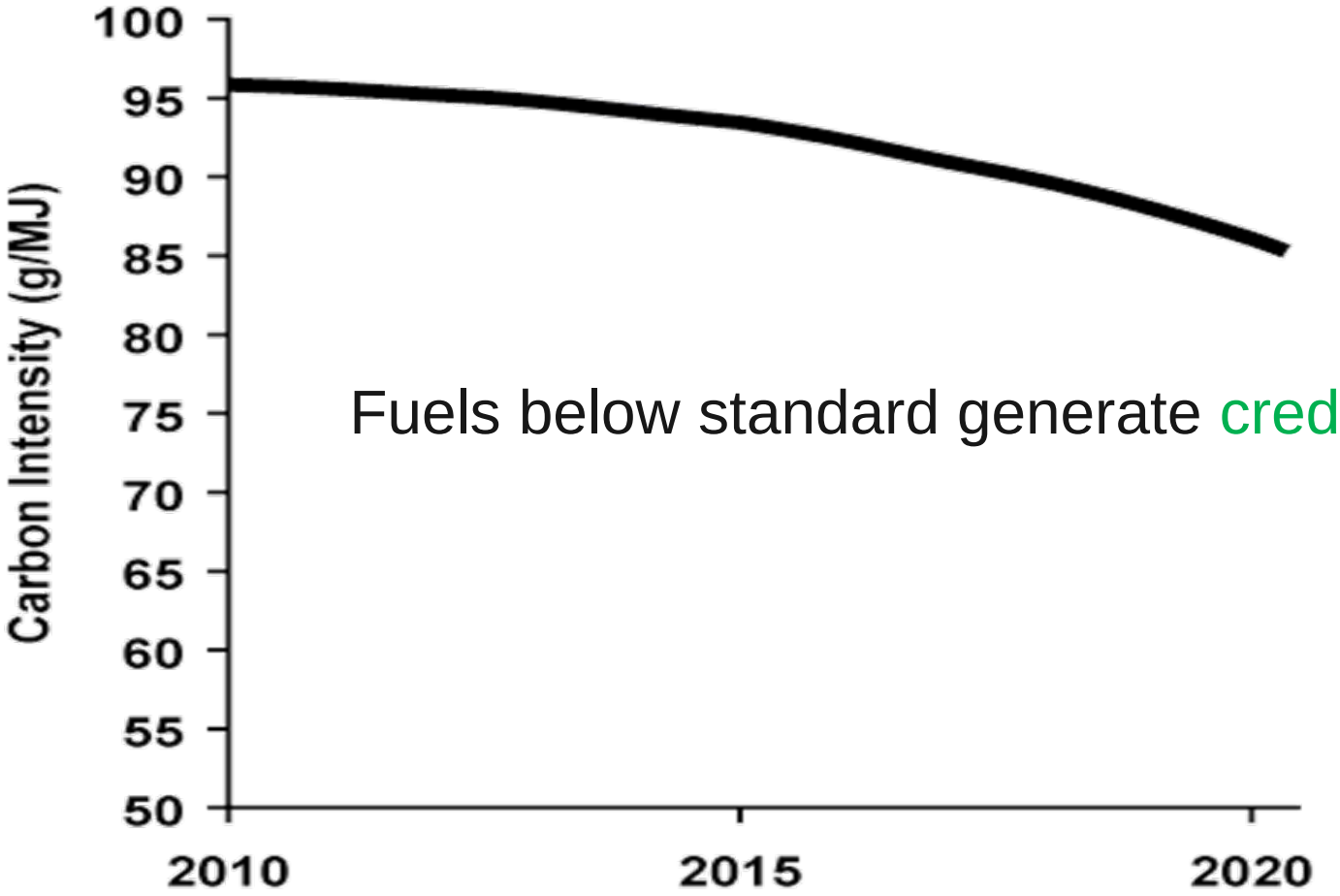


Fuel Life Cycle – Cellulosic Ethanol



Compliance with the LCFS

Fuels above standard generate deficits



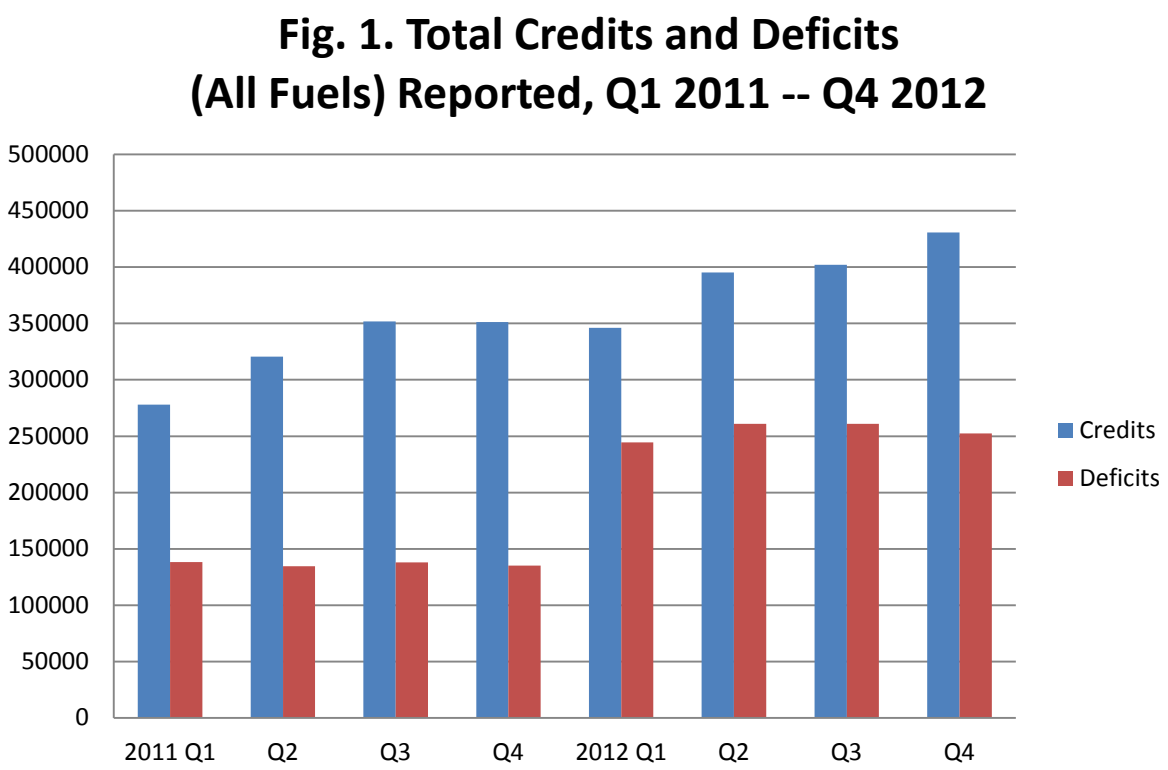
Fuels below standard generate credits

Carbon Intensities of Some Fuels

- Gasoline 99 gCO_2e/MJ
- Diesel 98 gCO_2e/MJ
- Corn Ethanol 73 - 121 gCO_2e/MJ
- Sugarcane Ethanol 58 – 73 gCO_2e/MJ
- Cell. Eth. (Forest) 22 gCO_2e/MJ
- Biodiesel 4 – 83 gCO_2e/MJ
- Methane **-15** – 83 gCO_2e/MJ
- Electricity 35 – 46 gCO_2e/MJ

LCFS Working As Designed

- Approximately 80 fuel providers are reporting & complying
- Credits being accrued, tradable any time (1,350,000 “excess” credits)



LCFS Credits

- Source of credits
  - 80% from low-CI ethanol
  - 10% from natural gas
  - 8% from biodiesel
  - 2% from renewable diesel
- Credit transactions
  - 1 LCFS credit transaction in 2011
  - 79 LCFS credit transactions through Q1 2013
    - Price range: $10 - $47/MT
    - Trade volumes: 13 – 47,505 credits/trade

Challenges

Other Challenges for Biomass-Based Fuels

- Financing
- Steady, long-term feedstock supply
  - Not merely forest thinnings
  - Requires multiple sources of feedstocks
- Energy crops – where to grow them?
- Infrastructure
- Permitting

For More Information

http://www.arb.ca.gov/fuels/lcfs/lcfs.htm